

WHAT IS CLAIMED IS:  
REVENDIGATIONS

Sub A17

1. ~~Method of modifying the geometric orientation of a digital image (I) in an image acquisition apparatus (20) adapted to acquire an image (I) in one amongst several different orientations and to store said image in the form of a compressed file, characterised in that it comprises the following steps:~~

- acquiring (E1) an image (I) in a chosen orientation;
- identifying (E2) said chosen orientation;
- converting (E3) said image into a digital image;
- spectral transformation (E10) of said digital image;
- determining (E12-E15) a geometric transformation to be applied to said image acquired as a function of the chosen orientation;
- applying (E16-E18) the geometric transformation determined to symbols associated with spectral coefficients issuing from said spectral transformation;
- recording (E20) in the compressed file two indicators (Ih, Iv) representing a normal or reversed order of the symbols respectively in two directions of the digital image (I); and
- coding (E21) the digital image in said compressed file.

2. Geometric orientation modification method according to Claim 1, characterised in that it includes a step (E11) of quantizing the spectral coefficients before the step (E16-E18) of applying the geometric transformation, said symbols being quantization symbols.

3. Geometric orientation modification method according to one of Claims 1 or 2, characterised in that said spectral transformation is a multiresolution decomposition, such as a wavelet spectral decomposition.

4. Geometric orientation modification method according to one of Claims 1 to 3, characterised in that the step (E12-E15) of identifying the chosen orientation is implemented by an automatic orientation detector (27) incorporated in said image acquisition apparatus (20).

5. Geometric orientation modification method according to one of Claims 1 to 3, characterised in that the step (E12-E15) of identifying the chosen orientation is implemented by a manual orientation selector (28) incorporated in said image acquisition apparatus (20).

5 6. Geometric orientation modification method according to one of Claims 1 to 5, characterised in that the image acquisition orientation is chosen from amongst a rotation through 90 degrees, a rotation through 180 degrees or a rotation through 270 degrees.

10 7. Geometric orientation modification method according to one of Claims 1 to 6, characterised in that said spectral transformation is a multiresolution spectral decomposition, such as a wavelet spectral decomposition, and in that it also comprises a step of transposition (E19) of a frequency sub-band ( $HL_1$ ,  $HL_2$ ,  $HL_3$ ) having coefficients of low frequency in a first direction of the digital image and of high frequency in a second direction of the digital image with a frequency sub-band ( $LH_1$ ,  $LH_2$ ,  $LH_3$ ) of the same resolution level in the spectral decomposition, having coefficients of high frequency in said first direction and of low frequency in said second direction when the geometric transformation comprises a rotation through 90 degrees or 270 degrees.

20 8. Geometric orientation modification method according to one of Claims 1 to 7, characterised in that it also comprises a step of transposition (E19) of the values of the height and width of the image when the geometric transformation applied comprises a rotation through 90 degrees or 270 degrees.

25 9. Device for modifying the geometric orientation of a digital image (I) incorporated in an image acquisition apparatus (20) adapted to acquire an image in accordance with one amongst several different orientations and to store said image in the form of a compressed file, having:

- 30
- means of acquiring (21, 22) an image (I) in a chosen orientation;
  - means of identifying (27, 28) said chosen orientation;
  - means of converting (23) said image into a digital image;

- means of spectral transformation (24, 29, 30) of said digital image;  
- means of determining (24, 29, 30) a geometric transformation to be applied to said image acquired as a function of the chosen orientation;  
- means of applying (24, 29, 30) the geometric transformation determined to symbols associated with spectral coefficients issuing from said spectral transformation;  
- means of recording (24, 29, 30) in the compressed file two indicators (Ih, Iv) representing a normal or reversed order of the symbol respectively in two directions of the digital image (I); and  
- means of coding (24, 29, 30) the digital image (I) in said compressed file.

10. Geometric orientation modification device according to Claim 9, characterised in that it has means (24, 29, 30) of quantizing the spectral coefficients adapted to quantize said spectral coefficients before application of the geometric transformation, said symbols being quantization symbols.

11. Geometric orientation modification device according to one of Claims 9 or 10, characterised in that said spectral transformation is a multiresolution spectral decomposition, such as a wavelet spectral decomposition.

12. Geometric orientation modification device according to one of Claims 9 to 11, characterised in that the means of identifying the chosen orientation comprise an automatic orientation detector (27) incorporated in said image acquisition apparatus (20).

13. Geometric orientation modification device according to one of Claims 9 to 12, characterised in that the means of identifying the chosen orientation comprise a manual orientation selector (28) incorporated in said image acquisition apparatus (20).

14. Geometric orientation modification device according to one of Claims 9 to 13, characterised in that the image acquisition orientation is chosen from amongst a rotation through 90 degrees, a rotation through 180 degrees or a rotation through 270 degrees.

15. Geometric orientation modification device according to one of Claims 9 to 14, characterised in that said spectral transformation is a multiresolution spectral decomposition, such as a wavelet spectral decomposition, and in that it also comprises means of transposition (24, 29, 30) of a frequency sub-band ( $HL_1$ ,  $HL_2$ ,  $HL_3$ ) having coefficients of low frequency in a first direction of the digital image and of high frequency in a second direction of the digital image with a frequency sub-band ( $LH_1$ ,  $LH_2$ ,  $LH_3$ ) of the same resolution level in the spectral decomposition, having coefficients of high frequency in said first direction and of low frequency in said second direction when the geometric transformation comprises a rotation through 90 degrees or 270 degrees.

16. Geometric orientation modification device according to one of Claims 9 to 15, characterised in that it also has means (24, 29, 30) of transposing the values of the height and width of the image when the geometric transformation applied comprises a rotation through 90 degrees or 270 degrees.

17. Geometric orientation modification device according to one of Claims 9 to 16, characterised in that the means for the spectral transformation of said digital image, the means of determining a geometric transformation, the means of applying the geometric transformation, the means of entering indicators ( $lh$ ,  $lv$ ) in the compressed file, the coding means, and if applicable the quantization and transposition means, are incorporated in:

- a microprocessor (24),
- a read only memory (29) containing a program for modifying the geometric orientation of a digital image ( $l$ ), and
- a random access memory (30) containing registers adapted to record variables modified during the running of said program.

18. An image processing method, comprising the steps of ;

- generating image data representing an image;
- wavelet-transforming the image data;
- quantizing the transformed data; and

- entropically encoding the quantized data, characterized in that said method further comprises the steps of:

- identifying a correct orientation of the image represented by the image data, and

5        - applying a geometric transformation to the transformed data in accordance with the result of the identification.

19. A method according to Claim 18, characterized in that the image data are transformed into sub-bands corresponding to each of a plurality of resolution levels in said wavelet-transforming step.

10        20. A method according to Claim 18, characterized in that the result of the identification is classified in four kinds of cases.

21. A method according to Claim 18, characterized in that said method further comprises the step of storing the information showing the result of the identification, and the encoded data.

15        *Sub A27* 22. ~~An image processing apparatus, comprising:~~

- means of generating an image data representing an image;
- means of wavelet-transforming the image data;
- means of quantizing the transformed data; and
- means of entropically encoding the quantized data, characterized

20        in that said apparatus further comprises:

- means of identifying a correct orientation of the image represented by the image data; and

- means of applying a geometric transformation to said transformed data in accordance with the result of the identification.

25        23. An apparatus according to Claim 22, characterized in that said wavelet-transforming means transforms the image data into sub-bands corresponding to each of a plurality of resolution levels.

24. An apparatus according to Claim 22, characterized in that the result of the identification is classified in four kinds of cases.

25. An apparatus according to Claim 22, characterized in that said apparatus further comprises the means of storing the information showing the result of the identification, and the encoded data.

5 ~~Sub A37 26. Image acquisition apparatus, characterised in that it has a geometric orientation modification device according to one of Claims 9 to 17.~~

27. Digital photographic apparatus, characterised in that it has a geometric orientation modification device according to one of Claims 9 to 17.

10 28. Digital camera adapted to function in a still image mode, characterised in that it has a geometric orientation modification device according to one of Claims 9 to 17.

29. Storage means, readable by a microprocessor, characterized in that it is adapted to implement the geometric orientation modification method according to one of claims 1 to 8.

15 30. Storage means, readable by a microprocessor, characterized in that it is adapted to implement the image processing method according to one of claims 18 to 21.

20 31. Computer program product, loadable into a programmable processing apparatus, characterized in that it comprises software code portions adapted to implement the geometric orientation modification method according to one of claims 1 to 8.

32. Computer program product, loadable into a programmable processing apparatus, characterized in that it comprises software code portions adapted to implement the image processing method according to one of claims 18 to 21